od Defects --
from Tree
to Product

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Wood Defects — from Tree to Product

1. Healthy, high quality trees supply the wood that we need for high value wood products -- from utility poles,

2. to violins — that make our lives easier and more enjoyable.

3. Trouble for the people who need these products starts when the wood rots underground, unseen,

4. or out in the open,where it becomes an eyesore as well as a hazard.

5. But where did the problems really begin? Here, right after the tree is cut,

6. or sometimes in the mill yard,

7. or as the sawyer cuts the tree, or in some cases,

8. after the boards have been dried.

9. Although wood product problems can also start after the wood has been put into service, many have their origin even further back, here in the living tree.

10. The problems start in three major ways: from trunk wounds,

11. from wounds in the roots or root rots,

12. or from poorly closed and infected branch stubs.

13. Who or what causes these wounds? Very often we do when we go into the forest to collect wood. The large equipment we use is operated safely most of the time, but it also causes many logging wounds.

14. What happens after a tree is wounded? It responds by forming protective boundaries to wall off the defects. The pencil point shows a boundary formed by this spruce after it was wounded.

15. In this microscopic view of the spruce wood, you can see the difference between a row of boundary cells and normal cells. The barrier zone is very strong protectively, but weak structurally.

16. If stress or pressure is put on the tree or product, the wood will crack first along the barrier zone. These cracks are commonly called ring shakes.

17. Trees survive after injury and infection by setting boundaries that resist the spread of infection. Researchers have developed a model for this process. It is called CODIT, an acronym for Compartmentalization Of Decay In Trees. In CODIT, Wall 1 resists vertical spread, Wall 2 resists inward spread, and Wall 3 resists lateral spread. Wall 4 separates infected wood from new wood that forms after an injury.

18. After a tree walls off injury, and some stress is applied, or after the wood begins to dry, cracks often form. This is a typical cracking pattern associated with wounds.

19. This oak was wounded at the red arrows when it was very small. Later in the tree's life, lateral cracks spread outward from the barrier zone that formed after wounding.

20. Often, the wood separates after it begins to dry, as it did in this oak.

21. The same pattern can be seen in Eucalypt long after it was made into utility poles. Note that the lateral cracks do not go inward to the center of the stem, but out to a circumferential crack.

22. A similar pattern occurs after wounding in conifers and tropical trees, such as this teak. Note the lateral cracks at the 10 o'clock position.

23. Cracks are a major cause of defects in Eucalypt. These trees were wounded by fire many times during their lives.

24. Cracks can start when trees are very small. This peach was wounded at the red arrows, but may split much later at weakened areas indicated by green arrows.

25. This new, well-treated utility pole already has a small circumferential crack and two lateral cracks.

26. When researchers tested the section by dropping it, the lateral cracks split outward.

27. The same pattern occurs in this dried Eucalypt pole. Note that the lateral cracks start along the circumferential crack and move outward.

28. The very small lateral crack in this pole has yet to crack outward from a small circumferential crack.

29. Cracks in utility poles usually start from some boundary of decayed wood in the center of the tree and develop outward. This section was damaged by woodpeckers that drilled into the pole to feed on ants burrowed in the decayed wood. The decayed part was associated with old large branch stubs.

30. The small column of walled-off decayed wood you see here was a homesite for ants. Cracks developed outward and the ants used them for an entryway.

31. Root rot and root injuries are also major starting points for defects in trees and wood products. The rot in this basal section of a Norway spruce was associated with <u>Fomes annosus</u>.

32. A longitudinal cut above the rot zone shows the boundary that separates sound wood from infected wood. If wood on the inner side of the pencil is used for a product it will fail very soon.

33. Often cracks will spread great distances above the wound site. When these distant sections are used for wood products, the wound is usually left behind in the forest.

34. The boundary zone - wall 4 - in this sugar maple, shows when the tree was wounded. The wood on the inner side will dry a different shade from the wood on the outer side of wall 4.

35. After injury, maples form vessel plugs as shown here. Other species of trees will plug vessels and form walls to resist vertical spread in many different ways.

36. Central columns of discolored wood are common in many species of trees, both hardwoods and softwoods. The columns in this red maple are associated with large old infected branch stubs.

37. Recent research shows that the ability of a tree to wall off discolored and decayed wood is under moderate to strong genetic control. The sections shown here are aspen, all of which received drill wounds. Tree 13-2 was a very poor compartmentalizer, while tree 42-15 was a very strong compartmentalizer.

38. Sugar maple, birch and other species of hardwoods do not have a true heartwood. Often large maples, such as the one shown here, will have clear wood to the center. These trees are usually very strong compartmentalizers.

39. Branch stubs are a common starting point for discolored wood in trees. The discolored wood associaterd with branch stubs may be a different color from the sapwood, but in some cases it is more resistant to decay.

40. The same processes work for conifers as illustrated in this white pine. The pencil point shows the boundary between decayed wood associated with an old branch stub and the new healthy wood that formed afterwards.

41. Behind every large, poorly closed branch stub problems have already started in the living tree.

42. Trees with large, poorly closed branch stubs should not be used for high quality wood products, especially utility poles.

43. Dissection of the branch stub shows that the wood present when the branch died was first infected, and then infested with ants.

44. The wood present at the time the branch died was also infested with ants. Note that the central core of true heartwood and the outer core of sapwood are sound.

45. The line marked G in the center of this cedar indicates the position of the pole at groundline. The section to the left was below ground and the section to the right was above. When the large branch stub died the wood was first infected, and then infested by insects.

46. Branch stubs are often the starting point for problems in the living tree that continue to plague wood products such as this dissected utility pole.

47. The branch-stub-associated defect often appears as decay columns between sound central heartwood and sound, well-preserved sapwood.

48. This in-between pattern of decay often results in pole failures at groundline.

49. In small poles with large branch stubs, the center of the pole may decay. This pole is infected with brown rot. Note the abrupt end to the brown rot column on the left.

50. Discoloration of this pole shows the early development of decay associated with a small branch stub.

51. Wetwood, a diseased condition usually associated with high populations of bacteria, also often occurs around branch stubs.

52. Wetwood can cause all types of crack problems, especially when wood is dried in a kiln. True fir species are especially vulnerable.

53. Improper pruning starts many problems in the living tree, problems that are passed on to the product.

54. A flush cut on this black walnut invited internal cracks. Such trees are no longer suitable for high quality products.

55. The same holds true for conifers. The center cut is too close, while the one on the left is too long. Only the cut on the right is proper.

56. When harsh flush cuts are made on conifers, many boundaries form and may later spread to become long shakes or lateral cracks.

57. The same procedures apply to pruning dead branches. Never cut behind the branch bark ridge. Details on proper pruning are given in other slide presentations in this series.

58. Problems often start when trees are cut in the hot summer and left for long periods before being sawn into boards. Here the hardwood logs have been infected by many stain-inducing fungi.

59. In conifers, the stain is often blue or black. In utility poles, the stain may still be present many years later. Stained areas may not absorb preservatives and rot will start as it has here.

60. When the zones are decayed completely, this type of pattern will result.

61. A longitudinal section of the previous sample shows how abruptly the brown rot ends.

62. Here is a typical sample of white rot, which usually does not end abruptly.

63. In some utility poles, especially cedars, decay advances rapidly just beneath the surface.

64. By dissecting poles with a chainsaw, researchers learned much about patterns. The base of the center section was groundline for this large transmission pole of Douglas fir. Note how rapidly decay stops aboveground.

65. What can be done to improve the quality of wood products? First we must start growing high quality trees that are free of wounds and have very few large, open branch stubs. It <u>can</u> be done.

66. Then we need better inspection procedures of the tree before it becomes a product and also of the product in service. Some early defects were found and treated in this utility pole. Consequently, its useful life is greatly extended.

67. Your inspection technique is extremely important. If the technique causes more problems than it solves, it must be abandoned. In the process of taking cores for inspection several large holes were made in this utility pole. Decay started where the holes were bored and later plugged.

68. We need better inspection methods for utility poles and other wood products. A new electrical device offers many advantages.

69. The operator drills a very small hole into the tree or pole and inserts a special electrode. A reading of the electrical resistance in the wood then registers on a field ohmmeter. The patterns of electrical resistance indicate the condition of the wood.

70. This method has been tested on small trees, large trees, and utility poles in many countries of the world.

71. It has been used on bridges,

72. and even in the selection of woods for violins.

73. A common problem in inspecting utility poles is that the brown rot ends so abruptly, yet wood that appears sound is often very weak. These two dial-type meters show the differences in electrical resistance in the sound wood at the edge of the pole, and the sound-appearing wood above the obvious brown rot. The resistance of the rim is shown on the lower meter. Note that the reading is very high compared to the resistance shown above for the sound-appearing wood.

74. The meter can also be used with double needle probes to assess the pattern of electrical resistance at the base of a pole. The pattern of resistance will help to determine whether surface decays are present.

75. You can use a longer version of the metal electrode to determine the relative vitality of trees.

76. Researchers have developed a new version of the device. It contains a mini computer, a means for collecting large amounts of data, and connections for larger computers and chart recorders.

77. The waste of wood continues worldwide. These logs in central Europe were rejected because of many basal defects. They will be used for very low value products.

78. In another part of the world, Australia, cracks limit the use of many trees for high value products.

79. In the northwestern United States and around the world, wounds are still the major starting point for problems that follow all the way through to the wood product. It is time to focus on growing healthy, high quality trees.

80. It is also time to bring together the results of research. Because healthy trees mean high value wood products.

This has been a Forest Service presentation.